University Chronicle

VOL. III DECEMBER, 1900 No. 6

MACHIAVELLI AND MODERN INSTANCES —AN ACCOUNT OF MACHIAVELLI'S MAXIMS IN CONNECTION WITH EVENTS OF THE SOUTH AFRICAN WAR.*

By LOUIS DYER.

Bacon's and Raleigh's obvious perplexities regarding the Machiavellian state policy, which they advocated in common with most Englishmen of mark in their time, is surely quite genuine enough to make us certain that The Prince conveyed to them far more than the crude and prehistoric political doctrine that "the king can do no wrong." Read with light from the Discourses, the Prince will often appear to be a sort of pamphlet of the times, launched forth to gain the ear of the writer's contemporaries. To them the now long-accepted idea of nationality was vague and all but unknown, and they were unprepared as yet to allow any effective political *status* to the people. Strictly national feeling came as a surprise to many, as can be proved out of the mouth of Erasmus. While Machiavelli was writing The Prince, Erasmus was asking what sense there was in the ridiculous wars of his day between Christians. Why, he urged, should a paltry question of this king's title, that royal stripling's silly ambition, or another's

* An address at a University Meeting in the Harmon Gymnasium, Friday, November 9, 1900.

personal pique, make Christians forget the many bonds uniting them? Why not arbitrate? There are no end of bishops, abbots, and learned men, of grave magistrates whose adjudication ought, in common decency, to settle such matters. What must the Turks say of our wars? "Nowadays," he goes on to say, "your Englishman hates a Frenchman just for being French, a Scotchman because he is Scotch hates an Englishman, and so an Italian hates a German, and a Swabian, a Swiss."* Such was Erasmus' unsympathetic appreciation of the new political force that has found its full expression in the modern theory of state policy inaugurated by Machiavelli in The Prince.

It is not, therefore, an accident which led Cardinal Pole to include in one and the same publication his *Apologia*, or open letter to the Emperor Charles V., first a denunciation of his cousin Henry VIII. of England for yielding to the temptation of the devil in divorcing Queen Catharine and cutting off the English Church from the See of Rome, and, finally, the most unmeasured abuse of Machiavelli's Prince. Thomas Cromwell pressed upon him the loan of a MS. copy of it when Pole met him at Wolsey's in the year 1628–29. But Pole was offended by this offer, and says that he only read the book years afterwards, when he became willing to brave the risk of its perusal because he felt that the book "betrayed the enemy's secrets," and "contained the plan of campaign drawn up by Satan for the damnation of mankind." In Pole's view the severance of England from Rome was an act of civil war on Henry's part, and Machiavelli's Prince, which made out that such a severance was good policy, was a treasonable assault on the body politic of the Church Universal and the Holy Roman Empire. Far more enlightened than Pole in many ways, Erasmus was afflicted by the same purblindness when he insisted that the ties binding Christians together as Christians were far more numerous and effective than those national ideals which sundered them. These last he simply ignored, and

* *Institutio Principis Christiani*, 1516.

proceeded to beg the whole question at issue between the new order and the old disorder by proposing bishops and abbots as peacemakers. The real point at issue being whether ecclesiastical principalities should exist, he suggested referring the matter to the ecclesiastics.

The Prince, then, may be considered as, in some senses, a popular "broadside," written to gain a hearing for views which were more accurately and completely stated by Machiavelli in the Discourses on Livy and elsewhere. In our author's mind, the modern notion of the people as a nation involved several things not necessarily and ideally connected with it. First of all, it involved an unscrupulous and arbitrary over-lord, who should represent the people, speak for them, act for them, and be their defender against the anarchy which came, especially in Italy, with the political shipwreck of the Church and the Empire. This was the chief function of the prince, dreamt of by Machiavelli when he scrutinized Cæsar Borgia's atrocious career in the Romagnas and marked how it resulted in improving the condition of the Romagnol people.

There is certainly room for confusion of mind between the prince, on the one hand, whose treachery, bad faith, and brutal vulgarity are borrowed from the Italians of the Renaissance, whom he was primarily portrayed to represent, and the Roman people, the *popolo principe*, on the other hand, the "antique" efficiency of whose sovereign rule is lauded in the Discourses. That sovereign prince and this sovereign people belonged to different political worlds. Machiavelli is often, but not always, alive to this fact. He speaks of Italians, Spaniards, and French as the dry-rot *(corrutela)* of the world, and descants upon the "antique" life and virtues of contemporary Swiss and Germans. Also the unexpected vigor of England extorts from him an implied recantation* of his early and rather hasty declaration that Englishmen were fatally undisciplined.† And thus it

* Discourses, I, c. xxi.

† Rittratti delle cose di Francia.

appears that, when he surveyed Europe as a whole, our author distinguished the Swiss, the Germans, and the English as offering in modern days the counterpart of that political and military efficiency which he called *virtù*, and chiefly discovered in the ancient Romans; for England, though it did not require exactly Machiavelli's Italian prince in order to achieve full national independence, still required the princes of the House of Tudor, whose many Machiavellian traits are notorious.* Nor did Machiavelli conceive that the sovereign people of Rome dispensed with a period of equally essential rule by princes equally absolute. He speaks repeatedly of the early political education of Rome by Romulus, Numa, and the other kings. Thus we may sum up our author's teaching by saying that he may be thought of as regarding the new-fledged nations of Europe in his day as *in statu pupillari*. Machiavelli substantially said to his own generation: 'Be what you are not yet, and do what you obviously cannot, and you shall be as the Imperial Romans were—free; remain as you are, and do what you must, and you shall be subjugated by the prince. His work once well done, your children's children shall witness the coming of age of a nation, and the absolute prince shall give place to the sovereign people.'

As for Machiavelli's mood in regard to religion, I think it might be summed up if we were to make him say in blunt terms: 'Governors and governments in our day have their work cut out for them in saving our skins, therefore in politics the less said about saving our souls the sooner mended.' The course of events in modern times, so far as the temporal power of prelates, popes, and ecclesiastics are concerned, has very fully explained why Erasmus' notion of ecclesiastical arbitration was impracticable, and the records of modern history constitute one long *pièce justificative* for the eleventh chapter of The Prince, where our author gives reasons for excluding ecclesiastical principalities from practical politics. "These are the only princes who are happy

*See in particular an essay by Mr. Owen Edwards, M.P.

and secure," he there says. "They need no policy of state, for their subjects do not dream of expecting to be governed or in any way protected. No skill or effort is required of an ecclesiastical prince. When you have such a principality you've got it, and there's an end."

After all, efficiency is Machiavelli's final test for any and every form of state and frame of government. Apart from his obliquities of mind and limitations of vision, he divined the only real force that had not as yet been adequately utilized in the schemes of government propounded in his day. That force resided in the people, but, for the moment, in the people as represented by an absolute national prince. Every human institution needs, according to one of Machiavelli's soundest dicta, periodical renovation and consolidation by some sort of return or reversion to its primitive conditions, and this is true even of the spiritual government of the Church, which he declares would long before his time have made utter shipwreck had it not been for the movements inaugurated by St. Francis and St. Dominic, who preached poverty and the example of Christ, and thus neutralized the ruinous effects of evil living among prelates and at the Court of Rome.

"It is a simple matter," says Machiavelli,* "to divine the springs of that devotion with which a people aspires to liberty; for the facts of experience demonstrate that states have never either enlarged their boundaries or increased their wealth, except while they enjoyed liberty." If our author had ever read Herodotus, this might be supposed to come from the Father of History. At all events, it will seem to some a startling utterance to come from him who wrote The Prince. Possibly, if he were here, and we pointed out to him that without liberty Russia has vastly enlarged her dominions and increased her wealth, he might declare that Russia could not possibly be classed as a state. At all events, it is worth noting that in the Florentine Secretary's philosophy, as in so many others, the course of

* Discorsi, II, c. ii.

Russian policy is a vast and baffling anomaly. There is, however, another cardinal saying of his which does apply to Russia. Russia is wonderfully ready in her own way to incorporate new citizens. It is one of the Machiavellian dicta of which Lord Bacon was especially fond, and may therefore stand here in Bacon's words. "All States," says Bacon (Of Kingdoms and Estates), "all States that are liberal of naturalization towards strangers are fit for empire; for to think that a handful of people can, with the greatest courage and policy in the world, embrace too large extent of dominion, it may hold for a time, but it will fail suddenly. The Spartans were a nice people in point of naturalization, whereby, while they kept their compass, they stood firm; but when they did spread and their boughs were become too great for their stem, they became a windfall upon the sudden. Never any State was, in this point, so open to receive strangers into their body as were the Romans; therefore it sorted with them accordingly, for they grew to the greatest monarchy." With a slight alteration in the date of its diction, this passage might have been incorporated in the preamble unanimously adopted not many months ago by the Canadian House of Commons, "representing a people which has largely succeeded by the adoption of the principle of conceding equal political rights to every portion of the population," in declaring its support of the Imperial Government in the present South African War.

Here, then, we can see that Machiavelli, in spite of his attachment to what was then the coming political force, the principle of nationalities, would have solved the present difficulty in the Transvaal by saying to the Boers:—If you cling to your independence you must abandon all ideas of a South African Union under your control, since your acts convict you of utter incapacity for enlarging your dominion or increasing your wealth in a sound and permanent manner. The fact that you will not and cannot extend the privileges of citizenship to those within your borders renders your pretentions to figure among the Great Powers as an "Independent International State" politically absurd.

About a year since, Lord Rosebery compared the policy of the Boers in trekking off into the wilderness to that of the Mormons in withdrawing to far-off Utah, and the comparison holds good both in respect of the desire which these two otherwise very different communities had to isolate themselves from the common progress of the world, to "set back the clock," as his lordship phrased it, and also in respect of the "peculiar institutions"—polygamy in the case of the Mormons, together with certain very crude theological and ethical views; and in the case of the Boers equally narrow, though less crude, theological views, together with an ineradicable desire to "wallop their niggers" at their own discretion. A third point of analogy which showed itself in a practically identical form in Utah and in the Transvaal as soon as those retrograde communities had well established themselves, was in the problem of the Gentiles for Utah and of the Outlanders for the Transvaal. Both communities solved it in the same way, were guilty of the same violation of sound state policy, and we may therefore look confidently for the same issue in the case of the Boers which we have seen in the course of events in Utah. There are, however, in spite of these undeniable points of analogy, so many points of dissimilarity, that it might be felt there is serious unfairness to the Boers in working out in such detail as has here been done any such parallel between the Boers and the Mormons. The power of far-sighted military preparations, a certain chivalrous high-mindedness in actual war, a fine quality of patriotic self-devotion, and an admirable courage and skill in actual combat are all present in the Boers, and command a sort of admiration which would be ill-bestowed on any deeds of the Mormon saints.

Having thus by our comparison sinned against the Boers, let us restore the balance, and pay them the compliment of a comparison with better men than they. Their cause has several obvious points of analogy with the "lost cause" of the Southern Confederacy in North America.

Of course this analogy cannot be pressed too far without absurdity, but some light may come, I trust, and no offence be given, by pursuing this argument in a spirit of detachment, caught as far as may be from the mood of Machiavelli's Discourses. It is not unfair, I believe, to say that the charming and genial social life of the Southern planters involved "putting back the clock," as does the more forbidding and bleak temper of the Transvaal community. The trekking of the Boers into the Transvaal may be looked on as an act of secession, comparable—when we view the ultimate political action to which it has led—to the secession of the Southern States from the Union. The wholly successful scheme by which the Orange Free State has been involved along with the Transvaal, and the attempted annexation of portions of Cape Colony and Natal, have their American counterpart in the struggle which all but carried out of the Union several border states such as Missouri and Maryland, and quite involved others in the "lost cause." With certain obvious differences there is a close parallel between the pro-Boer Ministry at the Cape, backed by a widespread support from the Dutch throughout that Colony, and the pro-slavery Government of President Buchanan, which gave so much heart to the secessionist movement at the outset, and made President Lincoln's inauguration so precarious a matter. It must not be forgotten that President Buchanan was backed throughout the Northern States by a party who played much the same *rôle* now taken in South Africa by the Dutch. In the heat of those anxious days this party of Southern sympathizers got the lurid name of "Copperheads." Circumstances alter cases, and it will hardly be deemed necessary to resort to so vitriolic an appellation in South Africa, although signs are not lacking of great exasperation produced among British soldiers in the field by the activity of Dutch spies, whose transatlantic counterparts so tried the armies of the North. To mention just one more of the striking similarities in the situation created in South Africa by the present

war and that which President Lincoln had to face in the early sixties:—The United States army was largely officered by Southerners who went over to the Southern side carrying with them appurtenances of war, a military training received at the cost of the United States, and, in several extreme cases, actual forts and strongholds belonging to the Federal Government. All this had been made possible by a political situation at Washington, which has striking analogies with that created by the Boer oligarchy at Pretoria. The Boers used their exclusive political power to levy on the Outlanders the means for entering upon their long-projected war, just as the Southerners used their disproportionate representation in Congress—based upon their large population of disfranchised slaves and downtrodden proletarians—to make themselves ready for what Seward so graphically named "the irrepressible conflict." Thus the Northern citizen stood, before the Civil War, in a position analogous to that of the Outlanders, whose industry has supplied the means used by the Boers in making ready for their "irrepressible conflict." The Northerner, however, had his remedy, and used it by choosing Lincoln to be President.

But in the South there was a not inconsiderable body of white men who were practically, though not nominally, in the position of inferiority to which the Boers have reduced the Outlanders. They were known by the generic name of "poor whites," or called, less benevolently, "white trash"; and it is recorded that their social and political *status* was often not one to be envied even by the negro slaves. Such uncertain accounts as are given of Lincoln's ultimate ancestry in Virginia suggest that his family belonged to this class. If Sir Alfred Milner's description of the Transvaal Outlanders as in the condition of "helots" be deemed extravagant, he might, perhaps, be induced to amend it by substituting the American phrase "white trash." If the animus of the pro-slavery oligarchy in America towards their "poor whites" is defined and elucidated by the Boers' attitude towards their Outlanders, that of the Boer oligarchy

towards the native and semi-savage African aborigines is in turn illuminated by the resolute revindication of slavery by the American Confederates. The Southern Confederacy and the South African Republic resemble one another not only in numerous circumstances characterizing their respective struggles for international independence, but also in the nature of the egregious blunder in statecraft, regarded by each as a supreme counsel of political perfection. The foundations of both are slavery and an anxiously restricted franchise, together with a resolute and effective military organization of the governing few. It is not a little remarkable that the last half of our democratic century should have to record the fighting out of the same issues between the few and the many, slavery and freedom, in two great wars, one in North America, and the other in South Africa. The "lost cause" seems, indeed, to die hard, and only to disappear in one quarter of the globe in order to reassert itself elsewhere, and it remains hidden from us whether a third great contest may not be somewhere impending before Machiavelli's dicta that liberty is the first foundation of durable empire, and that only those states are fit for empire that are liberal of naturalization, pass into universal currency as the accepted axioms of every man's political philosophy. This being a very possible contingency, not only Englishmen, but we Americans also, must rejoice in noting the temper of patriotic unanimity in which the English people and the whole English Empire are entering upon a struggle which proves, upon close scrutiny, to involve, in the circumstances attending it, and, above all, in the motives underlying it, the political principles now apparently entrusted to the safe-keeping of English-speaking states, though an Italian first stated them in their modern form. We must also hail with delight everything which shows that to-day, as four centuries ago when Machiavelli noted it, England is intrepid in the prosecution of her war, "because of the wisdom of the king, and the fact that his kingdom is well-ordered and does not

neglect in times of peace the preparations required for war."

Just here, however, the objector will recur to the principle of nationality, and may urge that the Boers and the Afrikanders have as much right to organize themselves politically as any other nationality, and it will naturally be pointed out that the Southern Confederacy was not, like the South African Republic, of a different nationality from those against affiliation with whom it protested. I think the domineering temper shown by the eager haste with which various proclamations of annexation have been made in South Africa is enough to dispose of this point. The international independence of the military oligarchy of the Transvaal is only the more incompatible with the political organizations surrounding it and the rights of those dwelling within its borders, because its nationality is Dutch. Indeed, the Dutch are demonstrably unfit for empire just because they are peculiarly incapacitated for maintaining general control anywhere and at the same time respecting the legitimate susceptibilities of subordinated subjects and states. This is a problem which is in no sense solved by their colonial administration, and which, had they been capable of expansion, ought to have been solved in time to prevent the sundering of Belgium from Holland. Continued union would have been possible if the Dutch had shown political sense. When an appeal is made to the principle of nationality, and a claim to impose special institutions over a wide area accompanies it, the ultimate question must be one of military efficiency. Have the Boers the requisite material resources and military backing for their project of establishing their Confederate States of South Africa? If they have, their unfitness for empire still ensures its ultimate failure; if they have not, it will very soon give place to liberty and federation under the British Crown.

In his Art of War* Machiavelli declares that the ideal

* Book VII, towards the end.

military organization—by which he understood one after the manner of the ancient Romans—requires a state of a certain size, one whose prince shall be able to muster from among his own subjects 15,000 or 20,000 young soldier-lads. He maintained that no state smaller than this had any chance of permanent independence. Times have changed, and with them the art of war has grown so much more complete, the populations under various governments have so vastly increased that Machiavelli would have to raise his minimum very considerably. It is growing plainer and plainer that small Powers, though they be nations so far as language and institutions go, have seen their day, and are likely, without necessarily losing liberty or nationality, to be absorbed into larger empires. However this may be, Machiavelli would be bound to apply his own supreme test of efficiency in government, and here again he would find the Boers seriously deficient. His greatest merit lay in seeing things as they are, clearly and unflinchingly. Therefore, he would not have sympathized either with those who indignantly clamor for the independence of the Filipino Republic, or for those, if such there be, who would incorporate Kaffirs and Zulus into the South African body politic. He would, however, have read in the annals of the great American Civil War the lesson that a *status* of slavery for the semi-savages of our day was incompatible with a sound modern state policy, just as he recognized that in his own day the "antique" custom of enslaving prisoners of war was wholly out of date,* and strictly demonstrated that states who were chary of giving their franchises to new-comers were unfit for empire.

*Art of War, Book II., end

THE POETRY OF SOCIAL REFORM.*

By CHARLES MILLS GAYLEY.

That the camel should go through the eye of the needle is easier than that the literature of purpose should become poetry. For poetry is a natural movement, an unconscious product. When it professes a didactic aim it passes out of the ken of art. Preaching and teaching may justify oratory and science; they should not be urged as justifying the existence of poetry. They would make of poetry an instrument, a means to an end; whereas poetry is an end in itself. I do not mean that poetry is not ethical, but that it must not be pedagogic. At that word poetry shudders. Poetry is, indeed, based upon foundations of truth and right; not, however, to convince men of their value, but to utter their beauty. It fulfills truth and righteousness the more powerfully because unconsciously. It persuades without argument. It convicts without attorney or brief. It moves men by moving their hearts; it fires them with its own ideals; it deepens sympathy; it glorifies imagination; it changes the face of empires. Therefore, in a real sense is there such a thing as the poetry of reform; and in a real sense nowadays (when, on one side, art for art's sake is preached, and, on the other, a gospel of utilitarianism which banishes art), is it wise that we should consider the efforts which poet-reformers have made to assist the social progress of the century. We shall see that

*An address delivered, in November, 1900, before the Channing Club, San Francisco, and the Teachers' Institute, Willows, California.

though poetry cannot subordinate itself to the conscious inculcation of intellectual or moral ideas, it has contributed largely in this, as in other centuries, to their appreciation, because it has brought them home to men in terms of figure and of feeling.

I shall confine myself to some English poets and to the political, and sometimes economic, movements with which they were identified. Some of these poets are but names to us—more's the shame, for they were real enough persons to our grandfathers; none of them more so than Ebenezer Elliott.

We can hardly realize to-day the straitened condition of the English poor at the end of the Napoleonic wars. The unusually high taxation fell principally upon the shoulders of the middle and lower classes. Bad enough was the prohibitive tariff on corn and breadstuffs, upheld by great land-owners, though it resulted in famine prices for bread. If, in addition to this we estimate the temporary displacement of labor by the introduction of new machinery, we shall perhaps understand why it was that the gap between rich and poor daily widened, until, as Wilhelm Müller says, "the free Englishman who possessed neither pedigree nor property had a position scarcely better than that of the plebeians at the beginning of the Roman republic." Hence the anti-corn-law riots; hence in 1819, the massacre of Peterloo; hence the agitation against a legislative system that existed for the benefit of privileged classes; hence the corn-law rhymes of Ebenezer Elliott.

He was born in 1781, the son of a poor clerk in a Yorkshire iron works. From youth he knew the stringency of circumstance; his education was, therefore, self-acquired. "It was, however, not the bread-tax," says Dowden, "that first made him a poet, but a picture of a primrose in Sowerby's 'English Botany.' This sent him to the country lanes," and hence his rarer verse. But no less sincere, though less beautiful as more direct and fierce, are the "Rhymes" of 1827 and 1828. At the poetry of

"Child, is thy father dead?
Father is gone!
Why did they tax his bread?
God's will be done!"

it is easy to sneer, but not at the pathos; nor at the confidence in a larger hope:

"Mother says death is best;
We have no place of rest—
Yes, we have one!"

How to rouse the oppressed to a sense of their degredation Elliott knew—"Wilt thou," asks he of the Briton,

"—deaf to hiss and groan,
Breed white slaves for every zone?
Make yon robber feed his own,
Then proclaim thyself a man;"—

and how with righteous scorn to scourge the "powers" that with "pomp and gold and gem" insult the free. "Madmen," he calls them, in his Battle Song:

"Madmen! they trample into snakes
The wormy clod!
Like fire, beneath their feet awakes
The sword of God!"

But as here, so always, in the white light of his anger the saving heat is that of patience and of prayer. Of such is the noble proem to his People's Anthem:

"When wilt thou save the people?
O, God of mercy, when!
Not kings and lords, but nations!
Not thrones and crowns, but men.
Flowers of thy heart, O God, are they:
Let them not pass like weeds away—
Their heritage a sunless day.
God save the people!"

Through his Poet's Epitaph, Win-Hill, and the nature poems rings the same indignation; and in the same faith finds its response:

"But should'st Thou wreck our fatherland
And mix it with the deep,

Safe in the hollow of Thine hand
Thy little ones would sleep."

This is the poet of whom our own Whittier wrote:

"On these pale lips the smothered thought
Which England's millions feel,
A fierce and fearful splendor caught
As from his forge of steel.

Strong-armed as Thor,—a shower of fire
His smitten anvil flung;
God's curse, Earth's wrong, dumb hunger's ire,—
He gave them all a tongue."

To the overthrow of the detested bread tax in 1846, these nigh-forgotten rhymes contributed more than we know. None can tell to what degree their vividness and candor moved the hearts of Villiers, Cobden, and Bright; but these verses were themselves the heart of the movement of which those statesmen became the head.

I have lingered over Elliott because he builded so much better than he knew. He is the untitled founder of a line of devoted singers; harbingers of a brighter day,—many of whom, like him, spent themselves for poverty's sake and are not even shadowed in the memory of those who enjoy the fruit of their labors. Some, like Eliza Cook and Ernest Jones, were poets of the Chartist movement, which for some time ran parallel with the anti-corn-law, and aimed to supplement the First Reform Bill.

A superficial reader of English history might imagine that the Reform bill of 1832 was a panacea for the legislative evils of the day. The bill did much for the middle, but little if anything for the lower classes. The Chartist movement attempted to secure for all a share in the government. Several of its demands are so reasonable that we, who have fallen on happier times, wonder that they were not from the first made a subject of consideration: manhood suffrage, for instance, and vote by ballot, and the removal of the property qualification for eligibility to Parliament. The poor were once more alive to their

exclusion from the law-making body; feeling ran high; and the agitation for this "people's charter," begun in 1839, continued with crises more or less severe for ten years. Some of the leaders—Frost, for instance, and Feargus O'Connor, may have been fanatics, but other some, like the poetic Thomas Cooper, were both sane and unselfish. "Among them," says Justin McCarthy, "were men of great ability and eloquence; some were impassioned young poets, drawn from the class whom Kingsley has described in his Alton Locke; some were men of education. * * * So far as we can judge, all, or nearly all, were sincere." Elliott also supported this movement till he was driven out by its opposition to his Anti-Corn Law League, which the Chartists condemned as savoring of compromise.

Eliza Cook was not a great poet, but few English writers have had more instant vogue among the common people. Her verses are occasionally wooden and their sentiment trite: but they hold fast by truth; they have pathos, they are fraught with good sense, they inculcate manliness and patriotism. They strike home. "Onward" is her call to The People of England:

"Onward! Liberty and Reason!
This is now broad Europe's shout;
England, it were moral treason,
Were thy lion voice left out.

"Britons! keep your banner waving;
Hang it forth in Freedom's sun;
But beware the braggart raving
That would talk of sword and gun!

* * * * * * *

"Show that ye have sense and feeling,
Fit to gain and guard your place;
Let your own determined dealing
Meet oppression, face to face!

* * * * * * *

"Let the great ones, high in station,
Lift their eyes, and see at length,
Ye are pillars in the nation,
That alone insure its strength!

"Tell your rulers they must levy
Fairer weights on wearied backs!
Say the coffers that are heavy
Best can yield the heavy tax!

"Tell the Church, its first great Pastor
Had no gathered store to count;
Little had the Christian Master
For His 'Sermon on the Mount!'

* * * * * * *

"Show that ye have bravely risen;
That ye are not 'brutes' and 'fools;'
Say that ye will shun the prison,
When they give ye work and schools!

* * * * * * *

"Let 'the People' have their 'college;'
Untaught men are fearful things;
Only crucibles of knowledge
Serve to melt Crime's fetter-rings.

"Sons of England, be ye steady!
'Tis your heads, and not your hands,
That shall prove you fit and ready
To enlist in Freedom's bands."

One may grant at once the dearth of imagination and creative power, but one cannot deny the force of wisdom, indignation, and satire. Mr. Ingram falls into scholastic error when he writes "Beauty rather than morality may be the truest theme for poetry," for beauty is not a theme but an aspect of the significance of life with which poetry deals; still, he is right when he says, "The class of readers Eliza Cook appealed to were better able to understand and profit by moral themes than by æsthetic, especially when they were presented to them in a self-respective instead of in the usual maw-worm manner." Yet Miss Cook was by no means destitute of artistic power. No one who knows an English 'common' can fail to appreciate the realism of God Speed the Plow; and none who has an ear to hear can resist the music of

"There's the thick and dingled cover
Where the hare and pheasant play,

There are sheets of rosy clover,
There are hedges crowned with May."

A deal of æsthetic enthusiasm there is in these lines to the rich who count in coin the value of earth's gifts. "Your hives but hold my honey, for they all belong to me."

The poet is intensely national. Witness her Raising the Maypole and her lines on The Englishman. That a singer formerly so popular should now be known only by a domestic strain or two is odd. Born in 1812, she died only eleven years ago, after a period of ill-health which had long retired her from active life. But she accomplished that to which she had set her hand. "There shall never be one lost good," said Abt Vogler, "what was shall live as before."

Ernest Charles Jones, born in 1819, godson of that Ernest of Cumberland who became King of Hanover, was one of the young men of position and culture attracted to the Chartist cause by the conviction that under the agitation lay a real grievance, and by the hope that a representative legislature might provide a means by which the working classes should lift themselves out of their destitute and powerless condition. Admitted to the bar in 1844, with admirable training and influential friends, Ernest Jones had apparently a brilliant career before him. But as at eleven years of age he had run away from home to help the Poles, so now at twenty-five he ran away from his prospects in society and at the bar to speak and write for the people of England. To his ability as a speaker John Bright has paid the highest tribute. So did the government, which in 1848 clapped him into prison for an address that from our point of view is noteworthy for its eloquent common sense. For this alleged sedition he was sentenced to two years' solitary confinement on bread and water. During this period he wrote verses with pens made, Mr. Miles tells us in his Poets and Poetry of the Century, from rooks' feathers picked up in the prison yard and shaped by a razor lent him for his toilet. His ink was stored in a piece of soap. Some of these poems appeal to

one with particular force; for instance, that which closes

"They'll find me still unchanged and strong
When breaks their puny thrall;
With hate for not one living soul—
And pity for them all."

"His entire unselfishness," says Mr. Miles, "and his unbounded sympathy with the downtrodden and oppressed are everywhere demonstrated in his career." Again and again he declined comfort and affluence, preferring the hardships of the cause to which he had devoted himself. His will kept him an agitator, despised of the class in which he was born; his newspaper, Notes to the People, kept him poor. In spite of all, however, he rose to eminence as a barrister in Manchester, 1861–1869, was courted by various parliamentary constituencies, and just before his death was returned as member for his own town. When he was thirty years old and in jail, he had written "Hope's the lamp I'll take for sleeping when I wish the world good night." Broken by his labors for the poor, he took that lamp at fifty.

Of Jones' Songs of Democracy, the critic already quoted says that it is difficult to imagine anything better for their purpose, and that while they lack the bitter intensity of Elliott's Rhymes, they are, in their simple directness, better calculated for popular use. This verdict is confirmed by the Song of the Factory Slave:

"The land it is the landlord's;
The trader's is the sea;
The ore the usurer's coffer fills,
But what remains for me?

* * * * * * *

The camp, the pulpit, and the law,
For rich men's sons are free;
Theirs, theirs are learning, art, and arms;
But what remains for me?
The coming hope, the future day,
When wrong to right shall bow,
And hearts that have the courage, man,
To make that future *now*.

"I pay for all their learning,
  I toil for all their ease;
They render back in coin for coin,
  Want, ignorance, disease;—
Toil—toil—and then, a cheerless home,
  Their hungry passions cross,
Eternal gain to them, that give
  To me eternal loss!
The hour of leisure happiness
  The rich alone may see;
The playful child, the smiling wife—
  But what remains for me?

* * * * * * *

"We bear the wrong in silence,
  We store it in our brain;
They think us dull—they think us dead:
  But we shall rise again:
A trumpet through the lands will ring;
  A heaving thro' the mass;
A trampling thro' their palaces,
  Until they break like glass:
We'll cease to weep by cherished graves,
  From lonely homes will flee,
And still as rolls our million-march,
  Its watchward brave shall be:—
The coming hope—the future day,
  Then wrong to right shall bow,
And hearts that have the courage, man,
  To make that future now."

Justin McCarthy calls Ernest Jones "almost a genius." I hold that he is a genius, but forgotten for a while. His poems are songs, and to select is to mutilate. For they surge to a climax and sing as they go. What can be more passionate, more relentless, more inherently rhythmical than his Song of the Lower Classes:

"We plough and sow, we're so very, very low,
  That we delve in the dirty clay,
Till we bless the plain—with the golden grain,
  And the vale with the fragrant hay.
Our place we know—we're so very low,
  'Tis down at the landlord's feet:
We're not too low—the bread to grow,
  But too low the bread to eat.

* * * * * * *

"We're low—we're low—we're very, very low,
Yet from our fingers glide
The silken flow—and the robes that glow
Round the limbs of the sons of pride.
And what we get—and what we give,
We know, and we know our share;
We're not too low the cloth to weave,
But too low the cloth to wear!"

That is the whip-lash style that stings a people to a sense of its degradation; but here is the music of the march—the Song of the Day Laborers:

"Sharpen the sickle. How proud they stand
In the pomp of their golden grain!
But I'm thinking, ere noon, 'neath the sweep of my hand,
How many will lie on the plain!
Though the ditch be wide, the fence be high,
There's a spirit to carry us o'er,
For God never meant His people to die
In sight of so rich a store.

"Sharpen the sickle. How full the ears!
Our children are crying for bread!
And the field has been watered with orphan's tears
And enriched with their fathers dead,
And hopes that are buried, and hearts that broke
Lie deep in the treasuring sod:
Then sweep down the grain with a thunder stroke,
In the name of humanity's God!"

Though the social revolution of 1848 made no particular headway in England, more than its echo, something of its spirit, is caught in the verses of Massey and Brough. The elder of the two, Gerald Massey, born in 1828, had been a factory lad himself and had eaten the bread of necessity during his youth. But with indomitable energy he taught himself to write, and with sympathy devoted his best to the people. His Cries of 'Forty-eight are "full of passionate declamation," says Alfred Miles, but they are also full of hope and sound teaching. What could be better as a song for the discontented than that which begins:

"There lives a voice within me, a guest-angel of my heart,
And its bird-like warbles win me till the tears a-tremble start;
Up evermore it springeth, like some magic melody,
And evermore it singeth its sweet song of songs to me;
This world is full of beauty, as other worlds above,
And, if we did our duty, it might be as full of love."

As this is exquisite, so the Song of To-day and To-morrow is courageous, with the courage born of pathos:

" 'Tis weary watching wave by wave,
And yet the tide heaves onward;
We climb like corals, grave by grave,
That pave a pathway sunward;
We are driven back for our next fray,
A newer strength to borrow,
And where the vanguard camps to-day
The rear shall rest to-morrow.

* * * * * * *

"Though hearts brood o'er the past, our eyes
With smiling futures glisten!
For lo! our day bursts up the skies—
Lean out your souls and listen!
The world is rolling freedom's way,
And ripening with her sorrow;
Take heart! who bear the Cross to-day
Shall wear the Crown to-morrow!"

There are few nobler poets of the poor than Gerald Massey. With the exception of William Morris, I doubt whether any have evinced a truer inspiration or a surer genius. He is national to the core, optimistic, creative—this Christian socialist, friend, as his biographer tells us, of Frederick Maurice, Charles Kingsley, and George Eliot—this, the prototype of "Felix Holt, the Radical." Devoted though he is to a cause, Massey is not limited in range or theme; not a faddist. He has written poems of war and civil life and home, of nature and the individual soul as well, and with signal success. His conceptions are philosophical, his images full of beauty, his lines melodious. He has been well called "a born laureate of the people, one of the most thoroughly English poets of the century;" and

he is an anointed prophet of that highest of world faiths, Christian evolution:

> "Race after race hath caught its likeness of
> The Maker, as the eyes grew large with love."

It is a pity that our limits forbid the insertion of at least one of the clever and caustic Songs of the Governing Classes, written by Robert Brough, journalist and dramatic author. Published in 1855, they are characterized by hatred of shams, detestation of political self-seeking, and scorn of hereditary claims to govern or to oppress. The irony of The Marquis of Carabas, with its Beranger refrain is delicious:

> "Off with your hat! along the streets
> His lordship's carriage rolls;
> Respect to greatness when it shines
> To cheer our darkened souls!
> Get off the step, you ragged boys!
> Policeman, where's your staff?
> This is a sight to check with awe
> The most irreverent laugh."

Then follows the recital of his lordship's dignities, and deformities; his noble descent (from a king's cousin and an oyster wench), the adroit self-sacrifice of his forbears, and their well-paid duplicity:

> "Now see, where, focus'd on one head
> The race's glories shine;
> The head gets narrow at the top,
> But mark the jaw—how fine!
> Don't call it satyr-like; you'll wound
> Some scores, whose honest pates
> The self-same type present, upon
> The Carabas estates."

His brow is scarce wrinkled, "brows keep so, that have not got to think." His hand is tiny: it never penned a useful line; ne'er worked a deed of fame, save slaying one whose honor he had blasted.

"They've got him in. He's gone to vote
Your rights and mine away;
Perchance our lives, should men be scarce
To fight his cause for pay.
We are his slaves! he owns our lands,
Our woods, our seas and skies;
He'd have us shot like vicious dogs,
Should we in murm'ring rise!
Chapeau bas!
Chapeau bas!
Gloire au Marquis de Carabas."

Of similar style and equal bitterness is My Lord Tomnoddy, who "writes his name with indifferent ease, and is rather uncertain about the 'd's,"

"But what does it matter, if three or one,
To the Earl of Fitzdotterel's eldest son."

He's M.P. at twenty-one, though he cannot speak. He is lieutenant at twenty-three, captain at twenty-six, colonel at thirty-three, though "he never drew sword except in drill." Soon

"My lord in the Peers will take his place:
Her Majesty's councils his words will grace.
And what are his qualifications? *One!*
He's the Earl of Fitzdodderel's eldest son."

In this sequence belong also Mathilde Blind's vitrolic but unequal verses, entitled The Heather on Fire, with which she scored those who, in 1866, evicted their highland crofters, that the landlord

"might abide
In all the pomp and power of lordly pride,
Riot in lawless loves, or, if he please,
Have a refreshing change of palaces."

Here, too, should be recalled well-known strains of defiance and lament from the sister isle, too many to be named in detail, and too good to be huddled into selections —the music of Moore's Melodies, the liquid fire of Mangan's Dark Rosaleen, Lady Dufferin's Lament of the Irish Emigrant, Ellen O'Leary's

"The dead who died for Ireland
In exile—poor—in pain;
Dreaming sweet dreams of the hills and streams
They never should see again,"—

the verses of Gerald Griffin, and T. D. Sullivan, and many another.

The utterances of the better-known princes of song and champions of the oppressed, Swinburne and Morris, require separate treatment. The latter, perhaps, deserves to be considered with the creative idealists of the century, the philosopher-poets, the Wordsworths and Shelleys. As for Swinburne, though in his Songs before Sunrise he froths overmuch and unduly gnashes the teeth at "Man's royal ties, and great men's breath and words of kings," his spirit is a whirlwind and a consuming fire, and his music a wonder: trumpets and trombones and the barbaric clashing of cymbals, with lulling intervals of harp and lute; and so the sense is ravished with the sound. Maybe there is a meaning; if one will seek.

From the bewilderment of that we turn with gratitude to William Morris, who of the twain is the surer poet and saner guide. Through the very sectarianism of his Chants for Socialists breathes the hope of his humanity. "Is it war?" he calls to the rich:

"Is it war, then? Will ye perish as the dry-wood in the fire?
Is it peace? Then be ye of us, let your hope be our desire.
Come and live! for life awaketh, and the world shall never tire;
And hope is marching on."

Such masters of verse demand consideration by themselves. So does the poetry of an aspect of social reform—barely touched upon in this paper—the humanitarian. For the adjustment of industrial relations has given birth during this century to a poetry of starving children and stricken women which would fill a volume of itself.

THE POWER AND METHODS OF HEREDITY.

By Wm. E. Ritter.

II.

Discussion of the question of whether or not these extra-ancestral, or acquired, characters are transmissible is prone to run into the tangled and obscure ways of biological fact and speculation. It is, however, purely a question of fact with which we have to do; and a position with reference to it that is justified by the present state of science is dependent more upon the ability to withhold conclusions until the evidence is all in, and then rightly to estimate the value of this evidence, than upon deep learning in biological science.

One class of persons declares that such characters are transmitted; another that they are not; while a third is in doubt about it. The *onus* of the situation is evidently on the first class. A writer of good repute belonging to this class has recently affirmed that there is not a particle of proof that the particular characters considered by him are not transmitted. To this the doubting Thomases reply of course that the perpetuation of their state of mind requires only the pointing out of weak spots in the affirmative evidence. To present a proposition and then require those who express doubts about its truth to prove it *not* to be true, even though a certain amount of circumstantial evidence be adduced in its support, does not carry in science any more than in the law court.

Again, a rather widely prevailing attitude on the question makes it important to note that it is not incumbent on the doubter to maintain some counter theory to bolster up his doubts. It is, for example, frequently urged by transmissionists in support of their contention that many of the directions in which racial changes have gone, cannot be accounted for by any theory that excludes the transmission of acquired characters. Of course if it could be conclusively shown that any piece of actually accomplished evolution must of necessity have depended on such transmission, this argument would be valid. The thesis is not, however, that evolution is impossible without this assumption, but that the assumption itself is true, and as long as this is the position, those who hold it should stand up to the rack squarely. By so doing, the clinching evidence, which everybody is anxious to find, if it exists, will the sooner be forthcoming. The impossibility-of-improvement argument is found to be a frail breastwork when it is remembered that the doubter always may if he chooses remind him who takes refuge behind it, not only of the possibility but even of the probability, that factors in the evolutionary process as yet wholly unknown or unappreciated may turn up any day that will cut the ground from under him entirely.

I have stated that the gathering in of all the evidence and the cross-questioning of it thoroughly is the only way by which a position on the subject unqualifiedly justified by the present state of science can be obtained. It is manifestly impossible in the limits of a brief paper to examine more than a fragment of the evidence that has been offered. We must, therefore, get as much as we can by fixing our attention upon a few instances, as weighty ones as we can find, drawn from as many fields of biology as circumstances will permit us to enter.

I first take a case or two from the domain of man's efforts toward the training and improvement of animals. It is almost an axiom among breeders and trainers of

domestic animals that the offspring of trained animals inherit to some extent the accomplishments which their parents have acquired through training. The improvements that have been wrought in the speed of trotting horses, for example, are believed to be due, at least in part, to this cause. I select this case because it is held by transmissionists to be a particularly strong one, and further because there is a large body of precise data bearing upon it, and this has been carefully considered by an ardent upholder of the horsemen's belief in the matter.* According to Professor Brewer the earliest accepted three-minute record for a mile race in this country was made in 1818. From that time down to 1892 the improvement by decades, or nearly that, was as follows: for the first decade, from 3 minutes to 2 minutes and 34 seconds: for the second decade, from 2:34 to 2:31½; for the third, from 2:31½ to 2:29½; for the fourth, from 2:29½ to 2:24½; for the fifth, from 2:24½ to 2:17¼; for the sixth, from 2:17¼ to 2:13¼; for the seventh, from 2:13¼ to 2:08¾; then from 1888, the end of the seventh, to 1892, from 2:08¾ to 2:08½.

This continuous and marked improvement that has been going on for more than three-quarters of a century is to be explained, the author believes, on the supposition that "Selection has doubtless determined the proper correlation of the various organs involved in the especial evolution, but the increase in speed has only come along with the functional development, which was enhanced by special exercise in the individuals of successive generations." In other words, to state in definite terms what is implied in this explanation, any individual horse, X, highly exercised in trotting, begot progeny capable of trotting faster than this progeny would have been capable of had not the parent been thus exercised. To get positive proof of just this character is clearly impossible. We cannot know what might have been under different conditions in the breeding

* Professor W. H. Brewer, On the Hereditary Transmission of Acquired Characters. *Agricultural Science*, Vol. IV, p. 249, 1892.

of colts any more than in other classes of events. Evidence of nearly the same weight might be secured in a different way, however. It might possibly be determined whether colts sired by a trotting horse late in life after he had been rigorously and carefully trained, were on the whole faster than those sired by the same animal while young and not yet at all exercised. But evidence of this sort would, in order to escape the vitiating element of individual variation, have to be based on a long series of carefully controlled observations.

No facts of this nature have ever been produced so far as I am aware. At any rate none are presented in Professor Brewer's studies. And this is the only way, so far as I can see, by which direct and final proof could be obtained. The evidence relied upon is entirely indirect and presumptive. It must, consequently, be submitted to particularly close cross-examination. The first question that may be asked hinges upon the fact acknowledged by every transmissionist, and indeed expressly admitted by Professor Brewer, that selection and the training of each particular horse have counted for something—have been in part responsible for the results. If responsible in part, why not wholly? Is it known just what the limit of power of these factors has been in the process? Answers to these queries are not given. Should it be shown, then, that in other similar cases equal or greater improvements have been wrought where the possibility of the transmission of the effects of training are entirely precluded, and training and selection are the only factors that can be invoked, the presumption would rise *almost* to the level of demonstration that in the case of the trotters also these factors alone have been operative.

Such cases are furnished by college athletes. I have examined only the University of California records and the American Intercollegiate records; but have no doubt that every college in the land in which athletics have flourished and records have been kept for some years, would furnish

evidence of the same nature. For the sake of brevity I consider only the records of our own University. The following table has been made from data obtained from the last "Blue and Gold:"

UNIVERSITY OF CALIFORNIA ATHLETIC RECORDS.

Events.	1879–1885	1899	Actual Improvem't	Per cent. of Improvem't
100-yard dash	$10\frac{3}{5}$ sec.	10 sec.	$\frac{3}{5}$ sec.	3.6 +
220-yard dash	$23\frac{1}{2}$ sec.	$22\frac{2}{5}$ sec.	$\frac{29}{40}$ sec.	3.13 +
440-yard dash	$54\frac{1}{4}$ sec.	$50\frac{3}{5}$ sec.	$3\frac{19}{20}$ sec.	6.7 +
1-mile run	5:58	$4:38\frac{1}{5}$ sec.	$1:19\frac{4}{5}$ sec.	22 +
1-mile walk	$8:17\frac{3}{4}$	$7:24\frac{1}{5}$ sec.	$53\frac{11}{20}$ sec.	11.7 +
120-yard hurdle	18 sec.	$15\frac{3}{5}$ sec.	$2\frac{2}{5}$ sec.	13.3 +
High jump	5 ft. $5\frac{1}{16}$ in.	5 ft. $11\frac{1}{4}$ in.	6 $\frac{3}{16}$ in.	10.33
Broad jump	18 ft. $2\frac{1}{2}$ in.	23 ft. 4 in.	5 ft. $1\frac{1}{2}$ in.	27 +
Shot put	31 ft. 1 in.	40 ft. $5\frac{3}{8}$ in.	9 ft. $4\frac{3}{8}$ in.	30 —

Comparing the event in the athletic record that probably has the greatest similarity with the trotting race, *viz.*, the mile run, we find that the improvement in the mile run was 22 + % in twenty years, while that in the trotting race was 28.6% in seventy-four years. Or to put the comparison on a juster basis, during the first twenty years in which the running race was in vogue the record was improved 22 + %; while during the first thirty years in the history of trotting (data are not furnished for the first twenty years alone) the improvement was only 16.9%.

Various other deductions of interest as bearing upon our problem may be made from a study of the data, but want of space prevents me from noticing more than one other. It will be seen from the table of athletic records that the events in which the greatest improvements have been made are: the shot-put, the broad jump, the mile run, the 120-yard hurdle, the one-mile walk, and the high jump, while the least improvements have been in the three "dashes." In general this is the same order of improvement as that shown by the American Intercollegiate records; *i.e.*, it has been greatest in the

hammer-throw, shot-put, broad jump, pole-vault, 120-yard hurdle, and high jump; in all the others it being much less. That is, improvement has been greatest in those events that are most complex, or are farthest removed from the ordinary bodily activities; or that depend largely, as in the case of the mile run and mile walk, on great endurance. In other words, improvement has been greatest in those events in which practice would be expected to count for most, and where skill and devise—intellectual qualities—would come most into play.

There can be little doubt that should trial of horse prowess in ways more unusual and complex than trotting become popular, like hurdle jumping or going backward, for example, and should selection and training be as carefully practiced here as they have been for trotting, the improvement would be correspondingly greater.

We may summarize the results of this examination thus: We have here two cases in which marked and nearly equal improvements have been effected in performances by the animal organism of much the same character. In the one case the conditions under which these improvements were made, *i.e.*, all in one generation, preclude the transmission of the effects of training from having played any part, and consequently leave the elements of selection and training and skillful manipulation practiced in each individual instance as the only factors that could operate. In the other case there is consequently no ground for assuming that any other element was in operation, particularly since these elements were much the same in both cases.

One more of the numerous points that might be raised, and our cross-examination of this witness must close. It is recognized that improvement cannot go on indefinitely in any of these directions. Trotting and pole-vaulting, for example, will surely reach a limit some time beyond which there will be no further improvement, while horses and men remain essentially what they now are. Why should this be if the effects of exercise are transmitted? It

would appear that since the training has to be more and more rigorous and careful in order to excel, the more the record is improved, the greater instead of the less should be the likelihood that the effects would be transmitted; and the more so since the supposed inherited new qualities should be becoming better and better established as the generations become more numerous. The transmissionist runs into the limbo, in this class of cases at least, of having to explain how it is that as the conditions held to be most favorable for the transmission of acquired characters become better and better, the less transmission takes place, until finally it ceases entirely. If the reply be made that the very nature of the organism fixes a limit beyond which such acquisitions cannot be transmitted, the troublesome doubter will rejoin that this explanation is satisfactory only so far as concerns efforts that might be made which in themselves reach entirely outside the nature of the organism, like walking on the hands, for example, by man. If, however, it is insisted that the same explanation will apply as well to exercises like those here under consideration that fall strictly within the scope of the organism's normal activities, then the doubting Thomas will become all the more troublesome by pointing out that if this be so transmission of acquired characters, so far as use is concerned, is deprived of all power to modify the organism, and so of being instrumental in the production of new varieties; and so powerless as a factor in evolution, along this line at least. Some factor that *cannot be stopped* in its modifying influence upon the organism by the nature of the organism is precisely what the fact of evolution requires.

We may turn our attention now to a few instances from the realm of habit and instinct. Perhaps no case could be selected here on which transmissionists would rely more implicitly than that of the migrating habit of birds. This wonderful power is almost universally regarded as an instinct established in heredity through the transmission of an acquired habit. Mr. Leverett M. Loomis has been

investigating the migration of water birds along the Pacific Coast of North America for a number of years. His studies have been as extensive and careful as any that have ever been made in this country on this class of birds, and some of his conclusions* have a direct bearing on our question. I quote, the italics being mine: "These investigations seem to prove (1) that the Shearwaters off Monterey *find their position and shape their course by the landmarks;* (2) that *birds do not possess a mysterious superhuman faculty for determining direction*, else the Shearwaters would not have been bewildered in the fog."

"It seems reasonable to conclude that young birds in the journey from their birthplace to the winter home of the species *are dependent upon the guidance of the old birds who know the way, because they have traveled it.*"

It should be noted that this habit is one particularly well calculated to be transmitted. It is practiced by both sexes; it is begun while the individuals are young and is kept up regularly each year through their life-time; and it involves strenuous physical effort and the keenest sort of exercise of such intelligence as these animals possess. Some of the migrations considered by Mr. Loomis extend nearly half way around the earth, and the obstacles met, as storms and fogs and the procuring of food, are frequently enormous. We might have supposed that it would have become established as an instinct through natural selection alone; and in the absence of more evidence to the contrary it is highly probable that in some cases, at least, this has been done. At any rate, the evidence produced by Mr. Loomis and others that in some birds the migration is dependent upon the *guidance by landmarks* and *other physical conditions;* and upon what *each new generation learns* from older and more experienced birds, throws so much doubt upon the possibility of the transmission through heredity of this habit that evidence from this

*Leverett M. Loomis. California Water Birds, No. IV. Proc. Cal. Acad. of Sci., Zool., Vol. II, No. 3, 1900.

source must be set aside pending the production of a crucial instance.

With reference to the general question of the transmission of acquired mental traits, it must be admitted that the reading of the masterly chapter on instinct in The Origin of Species, and of such arguments as those contained in Mr. Romanes' essay on The Darwinian Theory of Instinct, produces a very strong general impression on one's mind that such transmissions do play an important part in evolution. When, for instance, one finds Mr. Darwin saying: "It cannot be doubted that young pointer dogs (I have myself seen a striking instance) will sometimes point and even back other dogs the very first time they are taken out," it almost seems as though further doubting is unjustified. If, however, one persists in his cross-examination, as he must if he is to be a loyal seeker after truth regardless of what authority his pursuit may lead him to traverse, he finds that the evidence everywhere falls a little short of conclusiveness. Let us take, for example, these instances of young dogs that point before they are formally taught to do so. That this happens cannot, I think, be denied. But, we are bound to inquire in each particular instance, is it certain that the animal has never during its puppy days or later seen its mother or any other older dog point? And this question becomes more and more pertinent the more we learn of the important part that imitation, even among very young animals, plays in their intellectual development. Again, there are well-nigh insuperable difficulties in the way of making sure that the particular acts are not after all ancestral in the full sense of the word, and hence accountable for through selection. That selection has been an important factor in all these cases there can be no doubt —and it should be noted that with all domestic animals it is not the slow-going, hesitating natural selection with which we have to do, but the rapid and sure selection by man. As regards the pointing habit, for instance, there can be no doubt in the mind of anybody familiar with the

ways of all sorts of dogs living under all sorts of conditions, particularly with dogs running free in the country, that the innate element needed for selection to work upon is nearly everywhere present. Almost any dog will occasionally, at the scent or suspicion of prey, stop suddenly, crouch, and hold up one fore foot; and this widely prevalent habit was unquestionably the starting place for what is now known as pointing. One might go on indefinitely, did time permit, with the cross-examination in this domain; but it is the less important to carry it further in that those interested may be referred to the excellent chapter on "Are Acquired Habits Inherited?" in C. Lloyd Morgan's Habit and Instinct.

The doubter, even though an unwilling one, who goes to the field of animal habit and instinct in search of convincing evidence that acquired characters are transmissible is obliged, so far as concerns anything yet in reach, to return empty-handed.

We may now examine a few instances from the physician's realm. I select first the question of the transmission of acquired deafness. Professor E. A. Fay* has published the results of his extensive studies on the marriage of the deaf, and they contain data of prime importance not merely for the special question of the transmissibility of acquired deafness, but also for the general problem now occupying us. This work is of great value not only from the fact that it is based upon a far larger number of records of marriages of the deaf than all previous collections put together, the author tells; but because of the searching character of the questions asked of the persons investigated, and the care and variety of the tabulations presented. Trustworthy records of 4,471 marriages are treated.

I reproduce only two of the tables, these containing, however, the essence of what is most important for our pnrpose.

* Marriages of the Deaf in America. Volta Bureau, Washington, D. C., 1898.

TABLE I [based on a known number of marriages]:

Marriages of the Deaf	Number of Marriages	Marriages Resulting in Deaf Offspring	
		Number	Percentage
One partner congenitally deaf; the other congenitally deaf or hearing	526	111	21.103
One partner adventitiously deaf; the other adventitiously deaf or hearing	1,155	40	3.463
Total	1,681	151	9.458

TABLE II [based on the number of children investigated, and the condition, but not the number, of parents]:

Marriages of the Deaf	Number of Children	Deaf Children	
		Number	Percentage
One partner congenitally deaf; the other congenitally deaf or hearing	1,307	265	20.275
One partner adventitiously deaf; the other adventitiously deaf or hearing	2,433	56	2.301
Total	3,740	321	8.583

The term "congenitally deaf" is defined as meaning afflicted with deafness that has existed from birth, while "adventitiously deaf" means afflicted with deafness that has come on, no matter how, since birth. A deaf person that has ever heard is classed as adventitiously deaf.

Congenital deafness and adventitious deafness would be, with some important modification of meaning, which I shall consider presently, ancestral and extra-ancestral, or acquired, characters, respectively. Using the author's terms for the moment as though exactly equivalent to our own, we see from the tables that while the likelihood of the transmission of the ancestral character is greater than that

of the transmission of the extra-ancestral in the proportion of six plus to one, there is yet a rather strong likelihood that the extra-ancestral character will be transmitted; for although we have no tabulated evidence as to the percentage of deaf children born to hearing parents, yet it is admitted on all sides that this is not as great as these tables show, *viz.*, 3.463% in one case, and 2.30% in the other for the transmission of acquired deafness. When, however, we come to consider just what is covered by the term adventitious deafness in the report, the evidence not only cannot be taken as proving the transmission of truly acquired deafness; but on the contrary must be held to be *almost* conclusive proof that such deafness is *not* transmitted. As already pointed out, by adventitious deafness is meant any deafness, no matter how caused, that is known to have come on after birth. Now if this class were limited so as to include only cases known to be actually acquired deafness, there would certainly be excluded many that are now included. Professor Fay fully appreciates the importance of this fact, and I cannot do better in considering it further than to quote his words: "When we remember," he says, "that what is transmitted is not really deafness, but some physical anomaly or tendency to disease of which deafness is but a consequence or the symptom, and that this anomaly or tendency may have been congenital in the parent though deafness did not occur until some later period in life, we see that, even where marriages of adventitiously deaf persons result in deaf offspring, it is possible that the characteristic transmitted may really be a congenital and not an acquired one." As a matter of fact it is not only possible, it is certain that in some cases at least, the characteristic transmitted is congenital and not acquired. For example, it is sometimes so in cases of nervous deafness technically so called. This form of deafness is known to come on quite late in life, and to be accompanied by a history that admits of no doubt of its being dependent upon some congenital "anomaly or tendency."

The only cases that could be admitted to the adventitiously deaf class were this to be made exactly to correspond to an acquired-deafness class would be those in which hearing had been destroyed during the life-time of the individual by some accident, as by a severe concussion; or by some disease, like scarlet fever or measles which so frequently carry deafness in their train. With such a limitation as this the percentage of deaf offspring would unquestionably be reduced. To what extent it is of course impossible to tell, but the facts taken altogether warrant the supposition that it would be very close, if not quite down to the figure that would hold for the deafness of children born to hearing parents.

Without taking up another specific instance of the supposed transmission of acquired disease, I make the general remark that while the belief in such transmissions is almost universal among physicians, this is perhaps the most difficult domain of all in which to search for the crucial instance. This peculiar difficulty is due chiefly to two things: in the first place, to the fact that congenital weaknesses and tendencies to disease are so given to lying fallow for indefinite periods in the constitution of the organism, awaiting the proper period in the individual's life to come around, or for the proper environmental conditions to present themselves; and in the second place, to the fact that all higher animals, particularly man and the other mammalia, are for so long a time and so constantly and intimately subject to the conditions and influences that beget the maladies common to their kind. Note the long period of infancy, for example, during which the helpless creature must be so closely cared for by its kindred, must even be fed, in the case of mammals, by a secretion from the body of the mother parent. What need of supposing bacterial diseases—which we now so well know include almost all diseases—to be inherited when there are such golden opportunities after birth to "catch" things! The prolonged human infancy that Mr. Fiske makes so much of is by no means all blessing.

And how in the world is anyone going to get *proof positive* of the transmission of such a thing as, for example, the *actually acquired* element in near-sightedness? And certainly in the face of such testimony as that produced by Professor Fay with reference to ear troubles nothing short of proof positive can establish the contention with reference to eye troubles.

In deference to the popular interest in the subject, something probably ought to be said here about the inheritance of the effects of injuries. In view, however, of the negative results that have been reached in every case where the subject has been systematically investigated experimentally, I need do no more than refer to some of the most noteworthy of these investigations. Among these I would first mention the reëxamination by Mr. Romanes, a transmissionist it will be remembered, of Brown-Sequard's famous case of inherited epilepsy due to mutilation, in guinea pigs. Romanes failed to confirm the results obtained by the French physiologist. Weissman's extensive series of experiments, with negative results, on breeding mice from parents with amputated tails may be next mentioned. Then attention may be called to the exceedingly important experiments, virtually, of the compressed feet of Chinese women, and of the heads of flat-head Indians.

In conclusion I may state in the form of a brief summary what, so far as I am able to make out, partly from evidence of the sort presented in this paper, but more from evidence that it has not been possible to touch at all, is the best that biological science is able to do at present with this difficult but vastly important problem.

1. Among the lower organisms, meaning by this not merely the protozoa and the protophyta, but including as well some of the lower metazoa and metaphyta, acquired characters may be transmitted,

2. Among the higher animals and man the evidence is not sufficient, in view of the many good grounds for doubt, to justify the conclusion that such transmissions ever do take place; and,

3. As the affirmative testimony now stands, if a few of the most probable cases should be accepted as valid, it would have to be recognized that the laws and conditions under which the inheritances take place are wholly unknown to us, and would have to be interpreted as in the nature of freaks and sports, and hence without much significance in the evolutionary process.

4. The immunity of the heredity-power of the organism from somatic influences has been gradually acquired in the course of evolution, and does not depend upon an initial, fundamental difference between Germ Plasm and Somatic Plasm, as supposed by the Weissmannean theory.

EVOLUTION AND THE THEORY OF PROBABILITY.*

By ALBERT W. WHITNEY.

I shall try to show you this evening how the study of organic evolution may be treated as an exact science. And there is need for such treatment; the workings of evolution can hardly be further illuminated without abandoning vague speculation about the strength and effects of heredity, natural selection, and variation, for exact definitions and exact measurements.

Now perhaps you are saying to yourselves: "We are about to be told how to know the height of a man from knowing the height of his parents." Not so; and still I insist we are dealing with an exact science.

If you throw two coins into the air I dare not say that one will fall head up and the other tail up. If you throw a million coins into the air, however, I dare say that the difference one way or the other from an equal division of heads and tails will not amount to the one five-hundredth part of the whole number of coins.

I dare not make a statement about a small number of coins, but I dare to make one about a large number of coins. I dare not make a statement about a single father and son, but I dare to make one about the million sons of a million fathers; I might tell you, for instance, what proportion of sons will be taller than their fathers. In this

*Read before the Science Association, March 21, 1900.

sense, from this point of view, our science is exact; and the point of view is well taken. Chemistry is counted an exact science, but we do not know the exact behavior of each molecule.

Before beginning with biology, I must say more of tossing coins and spinning tops and drawing balls from urns—exercises in which the laws of chance are most easily discerned. And here it is in place for me to explain that much of what I have to say to-night I have taken from the work of Karl Pearson, Professor of Applied Mathematics in University College, London. Of the rapidly growing literature on the subject, Quetelet's work in which he applied the theory of probability to the study of statistics and Francis Galton's more specific application of it to anthropology, particularly in his Natural Inheritance, are doubtless most important; but Karl Pearson, going on with the ideas of Quetelet and Galton, has perhaps done most to formulate the subject clearly.

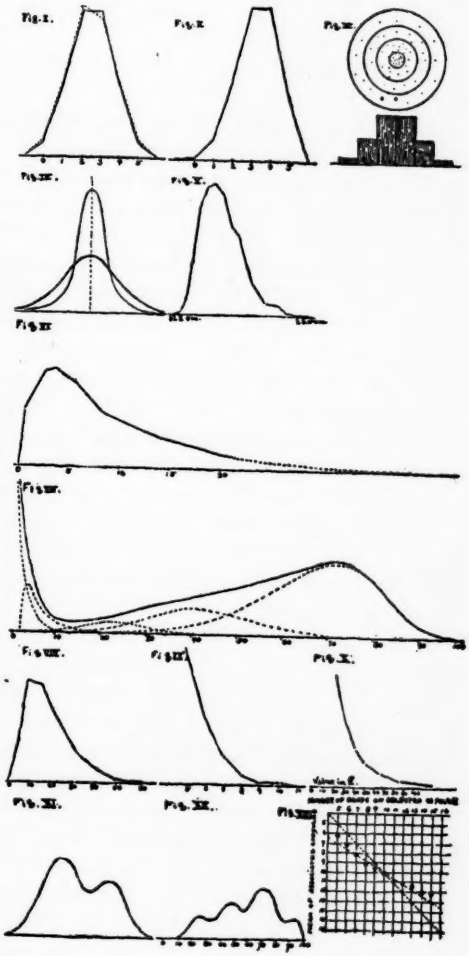
If you throw five coins into the air, some will come down heads up, some tails up; or perhaps they may all fall heads up; or all tails up. Suppose you do this a thousand times, keeping track each time of the number of heads; then count the number of times that no heads have come up, that one head has come up, two heads, three heads, four heads, five heads. You are right in suspecting that there will be an orderliness about these results, and hence in supposing that if another thousand trials were made the results would be nearly similar. The results in fact would not be far from these,—but wait, let me give you the result of 1,696 throws of five coins made by the members of one of my classes:

Number of times 0 heads came up	62	53
Number of times 1 head came up	257	265
Number of times 2 heads came up	546	530
Number of times 3 heads came up	504	530
Number of times 4 heads came up	259	265
Number of times 5 heads came up	68	53
	1,696	1,696

The numbers to the right give the most probable distribution, calculated very simply from the assumption that a head is as likely to turn up as a tail; you will notice the numbers are in the ratio 1:5:10:10:5:1 or the coefficients in the expansion of $(x+y)^5$ by the binomial theorem. You see the correspondence between the two series above is very close; and we may be very sure that the correspondence between two similar series for the case of say a million throws would be far closer.

If we form the ratio of each of the numbers in the columns above to 1,696 we obtain on the right $^1/_{32}$, $^5/_{32}$, $^{10}/_{32}$, $^{10}/_{32}$, $^5/_{32}$, $^1/_{32}$, the terms in the expansion of $(\frac{1}{2}+\frac{1}{2})^5$. These are the fractions that express the probabilities of the various occurrences; their sum is 1; this is to be interpreted as certainty, since some one of these possibilities must occur. We may illustrate all this graphically (Fig. I) by erecting as ordinates $^1/_{32}$, $^5/_{32}$, $^{10}/_{32}$ . . . . at points whose abscissas are 0, 1, 2 . . . . , taking more conveniently a larger scale for the ordinates than for the abscissas. We shall thus obtain a series of points which may be joined by straight lines out of deference to the eye's preference for a closed figure. The dotted line in Figure I represents similarly the actual result of the 1,696 throws.

If, instead of throwing coins into the air, we had spun five three-sided tops together one thousand times, each top having one side painted red, and had kept track of the number of times no red side, one red side, two red sides, etc., came up, we should have obtained a result much like the former one, but with this difference: before there was an even chance each time for head or tail; that produced a symmetrical distribution—there was the same chance with five tosses for three heads as for two heads; but with our top the odds are each time two to one against a red side coming up, and so there is not as great a probability of three reds as of two reds; we therefore get an unsymmetrical polygon, given in fact by plotting the terms of $(\frac{1}{3}+\frac{2}{3})^5$ (Fig. II). Tops with greater numbers of sides would give polygons with various degrees of asymmetry.



As the number of sides of our polygons increases, that is, as we throw up together a greater number of coins or spin together a greater number of tops, our polygons come to look more and more like curves, and our coin-tossing polygons in particular resemble a most interesting curve called the normal curve of probability; and, indeed, there is a real mathematical resemblance between the two.

When a rifleman shoots at a target, in general the bullets will prove to be distributed in a somewhat even way about the center; most thickly near the center with only a few scattering bullets at any great distance. If now, as the bullets strike the target they drop down into a receptacle with a level bottom and vertical partitions (Fig. III), the distribution of bullets will be another such as the distribution in our coin-tossing polygon. As the number of partitions increases, our polygon approaches a curve—the normal curve—whose equation is $y=Ae^{-Bx^2}$. A and B are constants for a particular rifleman and a particular number of bullets fired; A is the height of the curve; B is a constant that depends upon the accuracy of the rifleman. The area enclosed by the curve and the axis of abscissas represents the number of bullets fired. Figure IV shows the distribution of the same number of shots of a good marksman and of a poor marksman.

We may get a suggestion of the nature of the resemblance between this curve and our coin-tossing polygon by imagining a very mechanical rifleman who has succeeded in aiming his gun exactly at the center, but during the instant while he was pulling the trigger a succession of slight impulses, each equally likely to throw his gun to the right as to the left, has spoiled his aim. If we imagine that the gun is actually fired at the end of the fifth impulse we have a case exactly similar to our tossing of five coins; the probability of five successive impulses to the right is small just as the probability of a run of five heads is small; the probability of three impulses to the right and two to the left is the same as the probability of

three heads and two tails. If our rifleman had had a tendency to fire to the right rather than to the left, that is, if with our mechanical rifleman the impulses to the right had been more likely to occur than the impulses to the left we should have in the latter case a top-spinning polygon which in the actual case would approach a curve closely connected with the normal curve.

So far we have been speaking of cases in which some theoretical expression could be found for the law of probability, but there are thousands of cases where the presence of a law is evident but a deeper insight seems impossible. For instance, if we plot as abscissas the heights of men in the University and as ordinates the number of men or, better, the ratios of the number of men having these respective heights we shall have a polygon with considerable uneveness, to be sure, but nevertheless evidently approaching some curve as a limit, and as the number of men that are measured increases the polygon becomes more regular, just as the polygon representing some actual distribution of heads in the tossing of five coins becomes more regular as we increase the number of trials. Now the fact that we have before us a curve is a most significant thing. It shows us at once that behind what seems the fortuitous distribution of height there is a law, for a curve is the picture of a law. Now further, it is a fact—not to have been predicted beforehand—that this curve is very much like our normal curve. That we must interpret to mean that the impulses that tend to make a man differ from the most common height are of the same general character as the impulses that tend to spoil a rifleman's aim; that is to say, as likely to cause a less height as a greater height.

Such a curve as this is called a variation-curve or a curve of frequency. A great number of anthropometric and zoölogical data yield frequency-curves of very nearly the normal type. One who has begun to study such frequency-curves is led to plotting statistics of the most curious kinds, and the curves that result show that there

are laws underlying them all. For instance, the following all yield curves: barometric heights—barometric heights as abscissas, frequency of corresponding heights as ordinates (Fig. V); ages of women marrying men of a given age—for instance, from some large mass of marriage statistics which are easily to be had, pick out the marriages in which the husband is twenty-five years old; there will be a few wives of fourteen and fifteen, then a rapid increase to a maximum at perhaps twenty years, and then a gradual descent—men of twenty-five marry women of thirty, forty, fifty years, but less often as the age increases beyond the maximum at perhaps twenty; number of divorces in terms of duration of marriage—the abscissas give number of years of marriage, the ordinates the number of divorces for the corresponding length of married life (Fig. VI); mortality—the abscissas are ages, the ordinate for a given abscissa is the number that die at that given age (Fig. VII); mortality from enteric fever in terms of age (Fig. VIII); the petals of buttercups—the abscissas are the numbers of petals, the ordinate the frequency (Fig. IX); the value of houses—the abscissas are the values of houses, the ordinates the frequency of houses of the corresponding value (Fig. X); and so on through all the range of statistics.

The curves above are none of them true normal curves—the first two, barometric heights and age of women at marriage, closely resemble the skew top-spinning polygons, but the others are of still different type. We may generalize our coin-tossing and top-spinning in this way. Suppose a bag contains ten black balls and ten red balls. If you draw five balls, one at a time, each time replacing the ball, you have stood an equal chance each time of drawing a black or a red, and the law of probability of the various combinations is the same as for the tossing of coins. If, however, there are ten red and twenty black balls and the ball has been replaced each time, the odds are two to one for a black, and the law of probability is the same as for our top-spinning. But if the ball has not been replaced

each time the probability at each trial changes and we have a new law of probability.

Now, just as there are certain mathematical resemblances between the coin-tossing and top-spinning polygons and the normal curves and their skew relatives, so the equations can be written of a class of curves which have a certain resemblance to this new class of polygons. These new curves are of several types.

Now, you must understand that we can give no *a priori* reason why the tabulation of statistics should give frequency-curves of this kind; our reasoning has been merely that since we have observed that certain classes of statistics are representable by normal curves and their skew relatives, which are closely connected with our coin-tossing and top-spinning polygons, it may be that certain other classes of statistics will be representable by the curves connected with the *generalization* of our top-spinning and coin-tossing. The inference, if so, would be that while with certain classes of statistics representable by the normal curve (where the probability of variation in either direction is equal) or by the skew-curve (where a variation in one direction is more likely than a variation in the other), while in these cases, I say, the small impulses that determine a variation are independent of each other—that corresponds to putting the ball back again—in the latter cases these small determining impulses influence each other —that corresponds to not putting the ball back again. However that may be, it is certainly true that these new curves represent very well many new kinds of statistics.

The curves that concern us are the normal curve and the skew curve, for the great mass of biological statistics give either normal curves or slightly skew variations. Since we shall use these curves so much we must make a few definitions and observations. By *organ* we shall mean any measurable characteristic; in this sense we are measuring an *organ* when we measure stature, or length of arm, or the the thickness of a hair, or count the number of

petals. The *material* of which we are measuring an organ may consist of individuals—we may be measuring the stature of a lot of schoolboys; or it may consist of undifferentiated parts of the same individual—we may measure the thickness of the hairs on one head, or we may count the veins in the leaves of one tree. The whole area between the frequency-curve and the axis of abscissas represents the material to which the statistics have reference. This is more evident if our curves are thought of as generated in a somewhat different way; instead of plotting the number of men having a height between 5 ft. 8½ in. and 5 ft. 9½ in. as an ordinate at 5 ft. 9 in., let us make equal to this number the area of a rectangle standing on this one-inch base. Such rectangles indicate a curve, and it is evident not only that the whole area bounded by this curve represents the whole material under observation, but that the area between any two ordinates represents the material having an organ in size between the values of the two corresponding abscissas. This area divided by the whole area will give the probability that an individual taken at random will have an organ of a size between these limits.

The size of organ that is most common—the abscissa corresponding to the maximum ordinate—we shall call the *mode*, the fashionable size. The *average* size of organ—given by the position of the center of gravity of the area between the curve and the abscissa-axis—we shall call the *mean;* the size of organ that is as likely as not to be exceeded—given by the ordinate which divides the whole area into two equal parts—we shall call the *median*. In the normal-curve these three are all one. The difference between the mode and the mean may be taken to measure the skewness of a curve. Further, we need a measure of the concentration of the curve—the organ may vary between narrow or between wide limits. Such a measure may be the radius of gyration of the curve-area as it is swung about its center of gravity—*i.e.*, the distance of the point at which the mass of a thin plate of the same size and shape as the

curve area might be concentrated without changing the energy of gyration. This distance is called the standard deviation. For the normal curve in the language of the theory of errors it is the error of mean square. These definitions apply to any curve. In the normal curve, however, the curve is known as soon as the mean and standard deviation are given.

Now I want to emphasize still further the importance and significance of this curve of variation. Suppose we make measurements upon some organ in a great number of individuals of the same species. We shall obtain a frequency-curve whose mode and standard deviation show us at once the type of the species and its tendency to variation. This is what I want to say and to emphasize: this frequency-curve completely characterizes the species—with respect to this particular organ. If you should pick out some other large number of individuals from the same species you would get essentially the same curve. This frequency-curve *is* the species for this organ. If a species had twenty important characteristics, we should need twenty of these variation curves to describe it. The particularly simple case of two characteristics can be given a still more complete graphical representation. By representing, for instance, height by abscissas and length of arm by ordinates we may represent an individual with any combination of height and length of arm by a point in the plane. If now at each such point we raise a perpendicular of length equal to the number of individuals with this combination, we shall have a curved surface. This is the frequency-surface for the two organs. It tells us more than the two frequency-curves tell us. Sections of this surface by planes normal to the abscissa-axis and to the ordinate-axis would give, respectively, frequency-curves for length of arm for a given height and for height for a given length of arm. If we lived in space of twenty-one dimensions we might use twenty of them to locate points which should represent individuals having definite combinations of these

characteristics and the twenty-first to represent at each point the number of individuals having that particular combination. Since no such geometrical representation is possible and since even for a combination of two characteristics curves are so much more easily handled than surfaces, the frequency-*curve* is the basis for our work.

Now then, we start with these assumptions: In biological measurements our variation-curves will be normal or only slightly skew, provided the material we are measuring is homogeneous. This is, however, only a relative term and if we admit that homogeneity and normal curves are associated we may invert our statement and use it as a criterion for homogeneity. Suppose, for instance, we obtain a frequency-curve of this kind (Fig. XI). The inference would be that we have been measuring individuals that group themselves about two distinct types and that this curve is really the sum of two separate normal curves—that is, we have here either two species or two varieties. Here we have a suggestion of an exact criterion for species and varieties. Two groups of individuals should then be characterized as varieties or separate species according as their modes fall short of or exceed a certain standard divergence. But of course it will not do to determine the status of a group by an examination of the frequency-curve for only one organ.

A frequency-curve with two modes would result if the height of men and women in the University should be plotted together. The frequency-curves for the number of petals of flowers are often curious; such a curve may, for example, have separate modes, say of five, seven, nine, thirteen petals, showing that the species has several subtypes.

Practical use has been made of frequency-curves for the definition of groups. In England measurements of this kind have been made upon schools of fish to determine whether there is migration. It would be quite useless to try to discover whether a certain fish came from one school

or another, for in both schools there are fish exactly alike, but one school may have a curve with mode and standard deviation quite different from those of another. The English experiments showed, I believe, that the variation-curves for a certain fish were different for different points along the coast, but were the same at any one point at different times. That would seem to show that there was no migration.

Rather interesting examples of compound curves are sometimes gotten by plotting frequency-curves for the examination-marks of classes; plot, for instance, at 95 an ordinate of length equal to the number that received marks between 90 and 100, etc. The curve will very often have two distinct modes, showing that the class consists of two different types of students. There may be at least suggestions of still other modes. A system of classification of students into sections if it is not to be artificial should be based upon the examination of such a frequency-curve. A justification for a four-section classification would be such a curve as that of Fig. XII.

An interesting example of the resolution of a curve into component curves is Karl Pearson's resolution of the mortality curve. The curve is given in Fig. VII. You see that it means that out of say a thousand babies born, a great many die in the first few years of life; the mortality at thirteen and fourteen reaches a minimum; there is a gradual rise to a maximum at about seventy and then a falling off, indicating the few that are still living after that age. This is the curve that all life-insurance theory and rates are based upon. Pearson set himself to work to find whether it was possible to resolve this very complicated curve into constituents of our simpler types. One cannot help wondering whether there can be any *unique* resolution. Pearson believes there is: he found—by mathematical analysis of the curve—the only satisfactory resolution to be the following: first, a very nearly normal curve (very evidently the curve of old age,—you notice a few die of old age

at twenty-five and thirty); second, a middle-age curve with its mode about forty (this has not been interpreted); third, a low normal curve of young manhood (this has not been interpreted, unless it be due to the recklessness and love of danger characteristic of that age); fourth, a curve neither normal nor skew-normal, but of one of the types associated with our generalized drawing of balls, is almost exactly the curve that gives the mortality from scarlet fever and diphtheria (that of course suggests its interpretation); lastly, a very interesting curve that undoubtedly represents the deaths due to causes that had their origin in heredity or at least in events preceding birth. Pearson says he could not find a curve to represent this part of the mortality-curve until he let it extend back beyond birth; when we come to think of it that is what we should expect from the continuity of nature; curiously enough he found this part of the curve led him back over almost the exact length of antenatal life; this part of the curve agrees fairly well with statistics such as there are.

We have seen how a gunner's shots follow a normal distribution; it was natural then to personify the causes behind these five curves by gunners with varying precision and skewness of aim; Pearson found an artist who carried out for him this idea in the spirit of those weird mediaeval conceptions, the dances of Death, and the result is a very interesting picture, a symbolism as striking as Holbein's, and deeper because of its scientific import. The picture is the frontispiece in the first volume of some essays by Pearson called The Chances of Death and other Studies in Evolution.

I may speak here of a curious observation that Pearson makes about the curve giving the age of women that marry men of twenty-five. He found a skew-curve that fitted it fairly well up to thirty or thirty-five years, but from there on the curve ran higher than the statistics; he says that can indicate only that the women did not tell the truth about their ages. A similar case occurred during the civil

war: the curve giving the ages of men that enlisted was high out of all proportion at the age of enlistment.

Now we are only just ready to begin with the application of these ideas to the study of organic evolution, but just here I am embarassed by this very wealth of possible application, and I wish you to take what follows as merely a suggestion of what has been done and what may be done as fuller data come to be examined in this new light. Pearson's work has appeared for the most part in the Philosophical Transactions; the last edition of his Grammar of Science has an excellent short account of the subject. There is a general bibliography and other interesting matter, in a handbook called Statistical Methods, by Davenport of Harvard.

The factors of organic evolution are variation, selection, and heredity. We must study these quantitatively. You realize that our frequency-curve has already given us a picture of the variation within a species; but we must go further. If the organ that we had been measuring had been, for example, the number of veins on the leaf of a certain species of tree, we should have obtained a certain curve as usual. Now suppose we choose the leaves all from one tree; we shall obtain again a frequency-curve, not for the species but for this particular tree, and it will for this organ represent the tree in the same way that our first curve represented the species. The two curves in general will differ both in mode, showing the tree has a certain individual type, and in variability: the variability will be less than the variability of the species,—as we should expect; that is, the leaves from one tree look more alike than a lot of leaves taken from many trees and in general have a peculiar type. Let us study this from another point of view. Let us, for instance, study the resemblance between two flowers growing on the same stalk—sister-flowers, we may call them. Now we do not accomplish anything if we attempt to formulate the resemblance between an individual flower and its sister-flower any more than we accomplish something when we attempt to make a general formulation of

the resemblance between father and son by an observation of father and son taking the cases individually. We must take all the fathers together and all the sons together and study the resemblances of the average son to the average father, or better, we must study the frequency-curve for sons for a given organ in connection with the frequency-curve for fathers, or better still, we may plot a frequency-surface for the complex of sons and fathers. In our case, instead of father and son, we have sister-flowers. Let us then choose several thousand pairs of sister-flowers. The accompanying table I have copied from

No. of Stigmatic Bands on First Capsule.

No. of Stigmatic Bands on Second Capsule.	5	6	7	8	9	10	11	12	13	14	15	16	Total
5	.....	8	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
6	8	38	46	23	11	5	2	.....	.....	.....	.....	.....	133
7	4	46	184	163	146	78	31	8	1	.....	.....	.....	661
8	.....	23	163	390	398	279	111	75	32	4	.....	.....	1475
9	.....	11	146	398	554	415	250	161	68	9	5	.....	2017
10	.....	5	78	279	415	514	520	240	112	27	10	.....	2200
11	.....	2	31	111	250	520	770	366	160	53	9	.....	2271
12	.....	.....	8	75	161	240	366	252	178	35	12	.....	1327
13	.....	.....	1	32	68	112	160	178	92	23	11	.....	677
14	.....	.....	.....	4	9	27	52	35	23	28	12	.....	190
15	.....	.....	.....	.....	5	10	9	12	11	12	4	.....	63
16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	12	133	661	1475	2017	2200	2271	1327	677	190	63	.....	11,026
Means	6.33	7.11	8.22	9.06	9.51	10.12	10.73	10.96	11.19	11.82	12.05	.....	10.04

the Grammar of Science. Pearson found that the number of dark stigmatic bands on the capsule of the wild poppy was a characteristic easily observed and yielding a nearly normal curve. The table is made up of data from 5,513 pairs of sister-poppies. The table was made in this way: The capsules having, for instance, eleven stigmatic bands were selected; there were found to be 2,271 of such; the sister-capsules of these were then examined; these did not in general have eleven bands; only 770 of them had eleven bands, 366 had twelve, 160 had thirteen, etc. In fact these 2,271 sister-capsules of capsules with eleven bands form what is called an array and give a nearly normal frequency-curve by themselves. If we erected at each number in the table a perpendicular proportional in length to that number we should obtain a surface; the sections either way would be the nearly normal frequency-curves of the different arrays. We still have not come to the interesting point about this table, or this surface, if you like. Take the array of sister-capsules of capsules with seven bands; you notice that the mean is 8.22, that is, the sister of a capsule with seven bands has on the average 8.22 bands; similarly the sister of a capsule with eight bands has on the average 9.06; with nine bands, 9.51; with ten bands, 10.12; with eleven bands, 10.73; with twelve bands, 10.96; etc. You will see this more clearly from Figure XIII, where simply the means of the different arrays are plotted. You notice that for only one case is the mean for an array the same as the number belonging to the array; that is, the array of sister-capsules of capsules with ten bands, whose mean is nearly ten, 10.12; you notice that 10.04 is the mean of all the capsules. In all the other arrays there is a *regression* of the mean toward the general mean. You notice that these mean values nearly form a straight line. The slope of this line is taken as the measure of correlation. When the angle is 45° the correlation is perfect; there is no regression toward the general mean. If the angle is 0° there is no correlation; there is no more resemblance between sisters than between non-sisters.

This is only one of many instances of correlation. When we proposed to form a frequency-surface for length of arm and height, we had at our disposal data that would have shown correlation. We should have found a regression of the modes of our arrays—both for height for a given length of arm and conversely—along a straight line. Do you see that by this means when all the organs of a species have been correlated with each other we are able to determine for, say a given bone, the most probable values of the other organs and thus in a sense reconstruct the being to whom the bone belonged—Cuvier's suggestion?

Our first example of correlation suggests an interesting question. Suppose we determine the measures of correlation for pairs of undifferentiated like organs among all kinds of life; *e.g.*, choose 10,000 pairs of leaves, each leaf of a pair from the same tree; choose 10,000 pairs of hairs, each hair of a pair from the same head; etc. Determine the measure of correlation, and behold, it seems to be nearly constant, between .4 and .5; that is, the tendency for undifferentiated like organs to resemble each other is nearly the same all through nature. Pearson calls this a law of growth and compares it as to its being fundamental with the law of gravitation—it expresses the innate tendency of nature toward variation.

Another fact of growth is made clearer by correlation. Let us use Pearson's example. Plot as abcissas the height of boys at 11 years, as ordinates the heights of the same boys at 13 years. A boy who was 53 inches tall at 11 years and 55 inches tall at 13 years will be represented by a certain point of the plane. Erect at each such point a perpendicular of length equal to the number of boys having this combination of heights at 11 and 13 years. We shall have a surface; the sections of it by planes normal to the abscissa-axis will give arrays of heights of boys at 13 who were all the same height at 11; *i.e.*, boys do not all have the same rate of growth and therefore boys who were together in height at 11 will not be together at 13. We are

evidently here catching glimpses of very important laws of growth—perhaps of another fundamental law of growth.

Let us now use our graphical methods to discover the action of natural selection. The curve of an adolescent population will change, merely by the law of growth, even though the population be screened from natural selection. Now suppose natural selection to have acted, that is, in the struggle for life certain members of the population have been unfitted to survive, and have died; the curve will have changed still further, probably both in mode and standard deviation. Now the population may be so well adapted to its environment that this change will be simply repeated in each generation. This we shall call periodic natural selection. Periodic selection acts during growth, but produces the same adult generation each time. This is doubtless the type of natural selection that operates for the most part upon populations well established in stable environments. But this periodic natural selection may be accompanied by a permanent change of type; at each generation our curve may be changing its mode and variability; this change we say measures the effect of secular natural selection. The environment is no longer most favorable to the old mode; natural selection has acted to move the species toward a more favorable mode. The presence of natural selection evidently implies a relation between the death-rate and some organ; but the determination of this relation is made very difficult by the correlation among the different organs; natural selection may not be acting directly upon a certain organ, but indirectly through the correlation between this organ and some other organ upon which it is acting directly. Furthermore, natural selection may act directly upon several correlated organs at the same time,—one can easily imagine the resulting complication.

One of the chief demands we make upon organic evolution is for an explanation of the origin of species. Let us try to imagine the origin of a new species. Let us suppose

that migration has taken place, and that part of a species is under a new environment. The type best fitted to survive in the new environment will undoubtedly differ from the corresponding type in the old environment; secular natural selection will therefore operate to produce a new type, and, after a few generations, the two parts of the species may have very different curves. Or, it may be that without migration a sudden change in the environment has started natural selection to developing perhaps not simply one new type, but several. The question still remains—how to provide for the integrity of the new types? Here several factors may enter. For one thing, if we can show that the individuals of one class prefer to mate with each other, rather than with those of another class, we shall have a bar that will tend to keep the two parts from uniting. We are to inquire, therefore, whether like tends to mate with like; that is, we must see whether there is any correlation between mates. Pearson has made correlation-tables for husband and wife, and finds that there is a closer correlation with respect to height between husband and wife than there is between uncle and niece; and that there is a closer correlation with respect to eye-color between husband and wife, than that between first cousins. This we may call assortative mating. Its measure for a given organ is the correlation for mates.

A factor that will certainly be of importance in this connection is what we may call preferential mating; mating is preferential with respect to an organ when the frequency-curves for the mated and unmated parts of a population are different. A certain small number of data that Pearson had at hand seemed to indicate that marriage was more common among people with light eyes than among a general population.

Another important differentiating factor is differential fertility; fertility is differential if it is correlated with other characteristics. Instead of directly examining the correlation, we may more easily form a frequency-curve with respect to a given organ, for instance, first for wives

and then for mothers, and notice whether the curves differ. There is the same old difficulty in not knowing whether the correlation is direct or indirect. Pearson's data seem to indicate that in women fertility is correlated with height; in men, with darkness of eyes. It is evident that unless this reproductive selection is exactly balanced by natural selection it will tend to change the race-type until it becomes the type of greatest fertility, *e. g.*, daughters will grow taller,—as, indeed, they are believed to be doing.

We have spoken of the graphical way of discussing and measuring variation and selection; it remains to discuss heredity. Our first example of correlation developed a law of growth according to which like parts in an individual will obey a definite law of variation. This should hold true of the male and female gametes. The chance combinations of variable gametes will therefore lead to individuals obeying some definite law of variation. We therefore see that variability of the offspring is a consequence of variability of like parts in the individual. Heredity, however, is only, as it were, the obverse of variability, and so is also a corollary of variation in like parts. Thus, variation in the like parts of an individual and its corollaries, heredity and variation in the offspring, are seen to be fundamental organic laws. The measure of heredity is evidently the correlation between parents and offspring.

I hope this very inadequate account of this new method of attacking problems in the growth of organisms may nevertheless in a measure suggest its possibilities and how it will be able to give answers to very important questions that can be gotten in no other way; it is a method, however, as you readily see, that involves immense labor in the collection and treatment of the large bodies of data that it requires.

I would emphasize further that this method of examining statistics does not require that the curves be normal; the normal curve is merely the simplest form of frequency-curve, fortunately the most common, and its treatment is correspondingly simple.

CURRENT NOTES.

The thirty-fourth annual session of the California Teachers' Association was held in San Francisco December 26, 27, 28, and 29, 1900. Among the papers read were the following by members of the Faculties of the University of California;—before the Council of Education: Accrediting Systems—Universities, by Professor Slate; Legislation touching School Hygiene, by Professor Dresslar; Course of Study for High Schools, Mr. Heaton; The Past—Forecast of the Future, by Professor Brown;—before the Department of Classical and Modern Languages: Homeric Hiatus, Professor Clapp; Some Suggestions to Teachers of German, Professor Putzker; Medical Inspection of Schools, by Professor von Adelung;—before the California Association of Teachers of History: The Decline of Greece, by Dr. Ferguson;—before the Department of Child Study: The Function and the Scope of Foreign Languages in Secondary Schools, by Professor Richardson; The Function and the Scope of Science in Secondary Schools, by Professor Slate;—before the Department of Nature Study: Experiments in Plant Study, by Dr. Osterhout;—before the Department of High School Science: Laboratory Work in Botany, by Dr. Osterhout; The Importance of the Quiz on Text, Lecture, and Laboratory Work, by Professor Slate.

At the second annual session of the Philological Association of the Pacific Coast, held in the Mark Hopkins Institute of Art, San Francisco, December 28 and 29, the

following papers by members of the Faculties of the University of California were read: University Ideals, and The Legality of the Laws of Sound, or the Causes of Uniformity in the Phonetic Change, by President Wheeler; Grammatical Notes on Pindar—The Accusative Case, by Professor Clapp; Chinese Literature, by Professor Fryer; Fresh Light on Facts and Dates in the Life of Robert Greene, by Professor Gayley; Educare, Educere, and Educate, by Professor Merrill; Greek Elements in Schiller's Poems, by Professor Putzker; On the Form of Horace's Lesser Asclepiads, by Assistant Professor Richardson; and The History of the Contrary to Fact Construction in Latin, by Dr. Nutting.

The three-foot reflecting telescope presented to the Lick Observatory in 1895 by Edward Crossley, F.R.A.S., of Halifax, England, has recently been used in the production of stellar and nebular photographs. Of ten of these that were received by him, Professor H. C. Vogel, Director of of the Astrophysical Observatory at Potsdam, Germany, writes: "These photographs are in every respect the finest that have yet been made in the field of astronomy."

The following articles by members of the Faculties have recently appeared: Recent Progress in Geology, by Prof. Lawson, in the *International Monthly;* A Sketch of the Life of Daniel Cady Eaton, and Critical Notes on the New England Species of Laminaria, by Prof. Setchell, in the *Fern Bulletin;* A New Determination of the Minimum Visible and its Bearing on Localization and Binocular Depth (a paper read at the International Congress of Psychologists at Paris in August), by Prof. Stratton, in the *Psychological Review;* The First American College of Commerce, in the State University of California, by Prof. Page, in the *New York Commercial;* One Aspect of Vice, by Dr. Moore, in the *American Journal of Sociology;* Filar-Micrometer Observations of Asteroids, by Dr. Townley, in *Astronomische Nachrichten;* and An Application of the Group Theory to

Hydrodynamics, a deprint from the Transactions of the American Mathematical Society, by Dr. Wilczynski.

Years ago the general assembling of the whole University in the old Assembly Hall in North Hall on Wednesday afternoons to listen to lectures by distinguished visitors to the University was a feature of Berkeley life. The rapid growth of the University led to its abandonment, for there was no lecture-room large enough to hold even a single class. The enlargement and improvement of the Gymnasium has made it possible to re-establish the custom, and on Friday, October 12, the students were assembled to listen to an address by President Jordan of Leland Stanford Junior University on the importance to that University of the passage of the amendment affecting it to be voted on at the approaching election. On October 26, Dr. G. F. W. Holls, Secretary of the American Embassy at the Peace Conference at the Hague in 1899, gave an account of the work of that conference, and Father James Huntington, Superior of the Order of the Holy Cross, of the Protestant Episcopal Church, spoke on The Meaning of Good Will. Two weeks later, Dr. Kellogg greeted the students on his return from his trip around the world, and Professor Louis Dyer addressed them on Machiavelli and Modern Instances. On November 23, Regent Alden Anderson, Speaker of the Assembly, spoke on Arbitration, and President Wheeler on the University as a democracy. The last meeting of the term was on December 7, when Regent Chester Rowell was the speaker.